THE WEATHER AND CIRCULATION OF MAY 1955 [1]

Alleviation of Drought in the Midwest

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1. INTRODUCTION

Drought-breaking rains in the Great Plains and a continuation of unseasonably cool weather in the Far West (the sixth successive month) were the principal items of weather news during May. Drying winds and subnormal precipitation during March and April had depleted soil moisture over the Great Plains to the point where the crop prospects were seriously impaired. This trend, however, was completely reversed the latter part of the month when heavy extensive rains occurred which gave rise to considerable flooding.

2. THE MEAN CIRCULATION

The mean circulation for the month (fig. 1) contained a well developed westerly flow in the Pacific, a depressed but strong westerly flow in the Atlantic, and a somewhat weaker than normal westerly regime over North America. The Aleutian Low was quite near its normal position but more intense than usual with heights some 180 ft. below normal. Between this center and the zonal band of positive departures to the south (roughly parallel latitude 35°), the westerlies were up to 6 m. p. s. stronger than normal (fig. 2B). To the south of this strong subtropical ridge and in the region just north of the Hawaiian Islands, the easterlies were similarly enhanced by maximum values of 5 m. p. s.

The strong westerly flow in the eastern portion of the Pacific was instrumental in introducing repeated surges of maritime Pacific air into the mean trough in the western United States. These contributed to the unseasonably cool weather in that area which was characteristic of the entire month.

Over the United States the mean trough in the West (fig. 1) was observed well inland and extended from Idaho to southern California. The southern portion of this trough was situated approximately in its normal position but the portion over Idaho was located in a position where mean troughs are infrequently observed. In fact this area is normally occupied by a mean ridge. In the East, heights were everywhere above normal with the mean ridge line roughly parallel to the Appalachians. This pattern (trough in the West—ridge in the East) resembles that for April and has been typical of the Spring season as a whole.

In the western Atlantic, a blocking regime centered in the southern Davis Straits was effective in shifting the westerly jet well south of its customary May axis. This point can best be discerned from figure 2B which shows that departures above normal wind speed reached 6 m. p. s., equal to the maximum departure in the Pacific. Equal and opposite departures are noted in the vicinity of Greenland which was a region of exceptionally light wind movement during this month.

Typical of blocking regimes were the negative height departures from normal which were observed at middle latitudes in the western Atlantic to the southeast of the seat of blocking in the Davis Straits. Less typical however, was the anomaly of +120 ft. found to its southwest over the Great Lakes. It may be noted that this relationship was also present for the first half month (fig. 3A) even though the blocking activity was much stronger on that occasion as evidenced by the anomaly of +320 ft. in the Davis Straits. Thus, in this instance, the blocking was not effective in preventing ridging and positive anomalies over the eastern United States, a circumstance which was important in accounting for this month's warm temperature regime in the East. In the latter half of the month (fig. 3B) the blocking over Canada diminished and gradually extended its influence westward with a double anomaly center developing—one of +200 ft. in southern Greenland and the other of +160 ft. in southwestern Hudson Bay. This time, however, the latter was associated with the more usual negative anomaly on its southwestern side—heights were below normal over the south-central United States. This combination was associated with slow-moving storms well south of the normal track. These produced the heavy rains which were so badly needed to alleviate the worsening drought in the Plains area.

The presence of a blocking ridge again this May raises several points of interest. In writing of the weather for May 1954, Klein [1] described a similar blocking regime for that month with an anomaly of +380 ft. in the southern

[1] See Charts I–XV following page 115 for analyzed climatological data for the month.

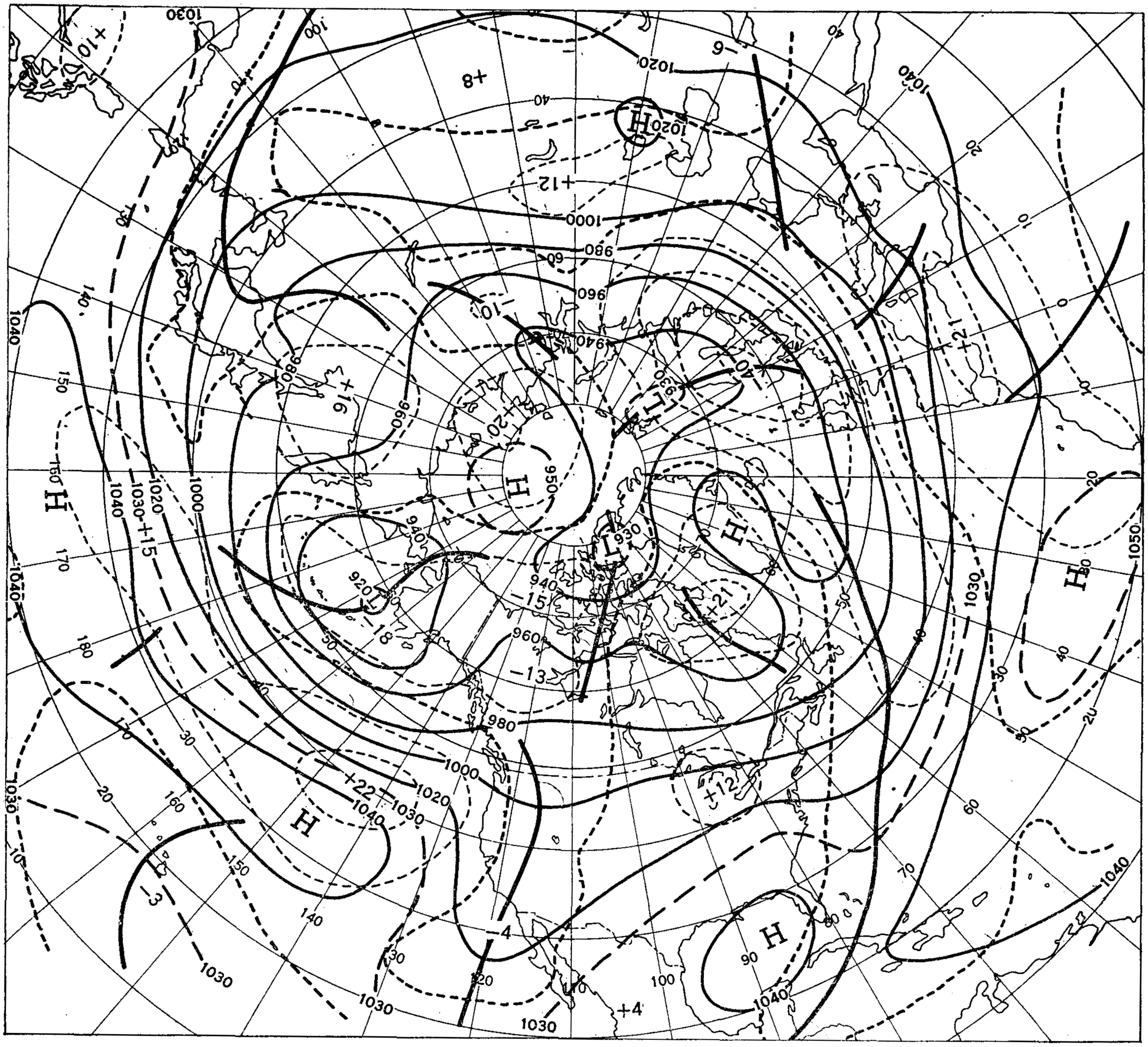


Figure 1.—Mean 700-mb. contours and height departures from normal (both in tens of feet) for April 30 to May 29, 1955. The fast Pacific westerlies were associated with repeated thrusts of cool maritime air into the mean trough over the western United States. Colder than normal air again dominated the West while temperatures under the ridge in the East were above normal.

Davis Straits. Also he prepared a composite 700-mb. chart for the previous eight Mays, 1946–1953, and again found that positive departures overspread this area with a central value of 160 ft. The repetition of this feature this May lends additional weight to the implication that either there exists an error in the long period normals used, or the past 10 years represent a secular trend in the general circulation.

The above indicated prevalence of the blocking regime in May is in good agreement with the results obtained by Rex [2] that Atlantic blocking activity for the periods 1933–1940 and 1945–1949 was more characteristic of May than any other month of the year.

An inspection of 5-day mean charts for this period reveals that blocking proceeded westward across the Davis Straits roughly in three waves: one early in the month, a second about mid-month, and the last toward month's end. Of these the second was most pronounced and produced a departure from normal of +660 ft. at the southern tip of Greenland for the 5-day period May 11–15. Twenty degrees due south of this abberation was a center of −590 ft. and the combined effect of the two was a very strong component of anomalous easterly flow.

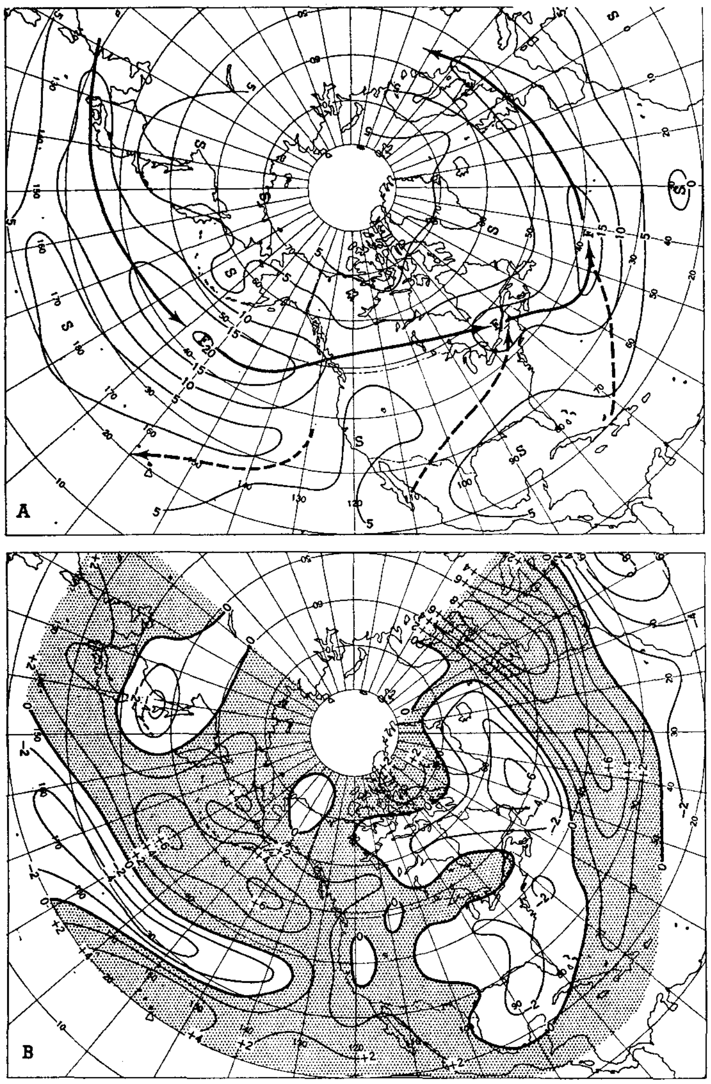


Figure 2.—(A) Mean 700-mb. isotachs and (B) departures from normal wind speed (both in meters per second) for April 30 to May 29, 1955. Solid arrows indicate major axes of maximum flow. The jet stream was well developed both in the Pacific and in the Atlantic, though farther south in the latter, with departures from normal speeds as high as 6 m.p.s. in both cases. Flow was much weaker over the United States and axes of flow were not as sharply defined. Note also the easterly maximum in the vicinity of the Hawaiian Islands.

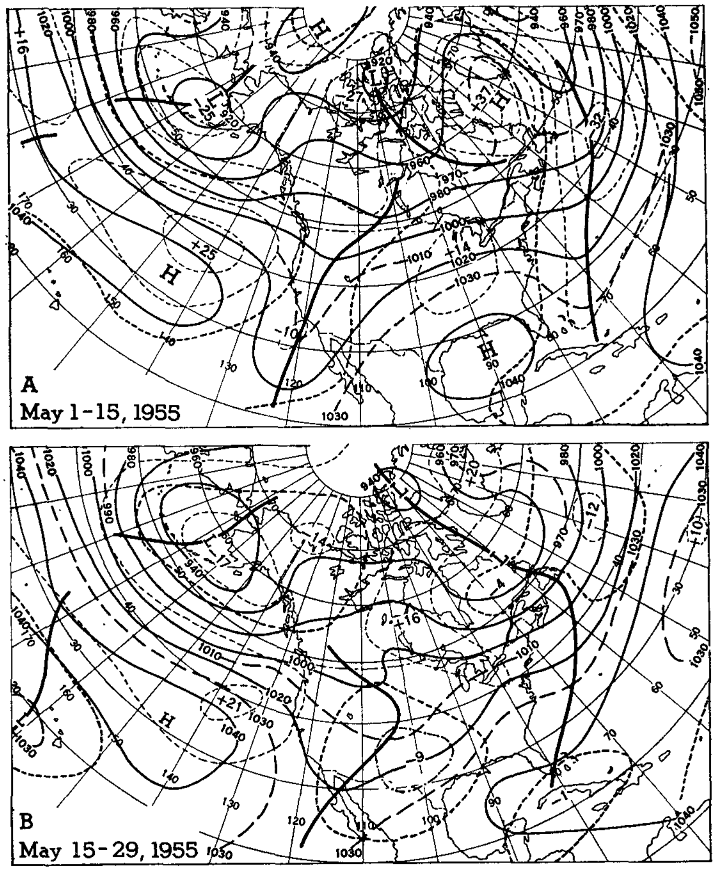


Figure 3.—The mean 700-mb. contours for (A) May 1–15, 1955, and (B) May 15–29, 1955. Anticyclonic conditions and positive departures from normal dominated the United States except for the Far West during the first half of the month. During the latter half, however, the trough moved eastward to the vicinity of the Divide with negative departures over a broad area centered over the Texas Panhandle. The drought-breaking rains of the latter half month were associated with this system.

The largest anomaly by far on the mean 700-mb. chart for the month (fig. 1) was the center of −400 ft. associated with the mean trough over Scandinavia. Between this depression and a band of above normal heights over the Mediterranean, the westerly jet stream was unusually well developed. In fact normal wind speeds in that area were exceeded by more than 8 m. p. s. as evidenced by figure 2B. Frequent cyclonic activity was associated with this current particularly during the first two decades of the month when a number of intense storms crossed the British Isles and stagnated in the vicinity of the mean depression over northern Scandinavia. This cold stormy weather was interrupted during the last third of the month when a series of blocking Highs appeared over Europe and the northeastern Atlantic.

Over eastern Asia, on the other hand, the circulation was more of blocking nature. An examination of figure 1 reveals two separate centers of positive anomaly. One of these of 200 ft. was located well to the north along the north Siberian coast, and the other of 160 ft. over northern Sakhalin. Blocking was particularly active the latter portion of the month and reached maximum development during the last week. During this interval heights were well above normal over almost the whole of Asia north of 30° N. with a maximum departure of over 600 ft. in central Siberia.

3. THE DROUGHT

As discussed in the April 1955 article [3] of this series, last month saw a gradual intensification of drought conditions over most of the Plains States. This moisture deficiency had been developing for several months and, as indicated in figure 4, rainfall totals for the 8-month period September 1954–April 1955 were subnormal. This tend-

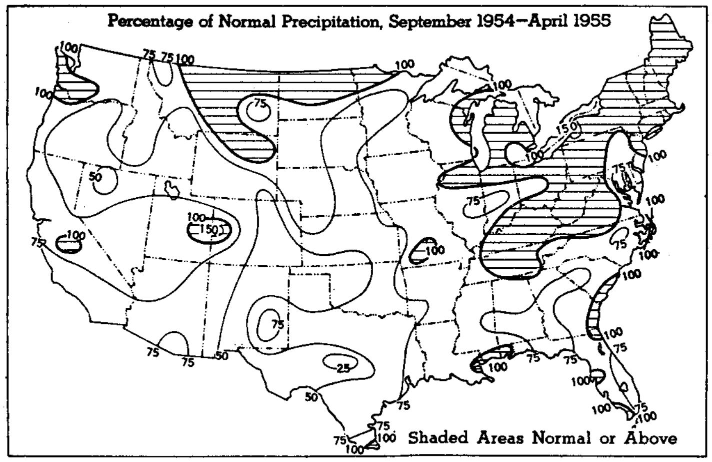


FIGURE 4.—Percentage of normal precipitation, September 1954–April 1955. Rainfall for the 8 months prior to May was subnormal over a broad area of the central and western United States and particularly so over the Plains States, most of which received less than 75 percent of normal. (From *Weekly Weather and Crop Bulletin, National Summary*, vol. XLII, No. 19.)

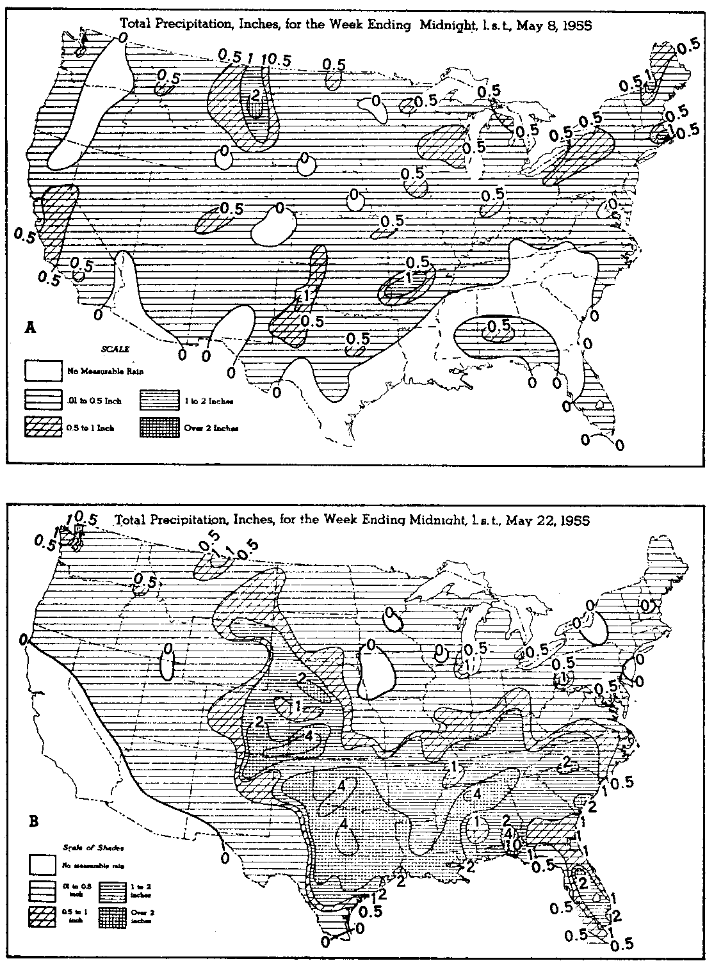


FIGURE 5.—Total precipitation in inches for the week ending midnight (A) May 8, 1955, and (B) May 22, 1955. The former is typical of the relatively dry rainfall regime of the first portion of the month and the latter of the wet regime in the central and southern Plains States and in the Southeast in the second half of the month. (From *Weekly Weather and Crop Bulletin, National Summary*, vol. XLII, Nos. 19 and 21.)

ency continued into the first portion of May when hot, dry, and windy weather further sapped the already deficient soil moisture to the point where crops were damaged or destroyed and soil erosion and drift were setting in.

This trend was effectively reversed during the latter portion of the month when abundant precipitation fell over the affected regions. The first precipitation received was in the form of showers as a squall line proceeded across the Texas-Oklahoma area on the 11th and 12th.

While highly beneficial in some areas, amounts deposited by this storm were irregular and spotty and general relief was not afforded. This was particularly true of the far western portion of the Plains States.

More substantial alleviation resulted as a second storm moved across the area on the 17th, 18th, and 19th, accompanied by very heavy rains and squalls with amounts ranging from 1 to 10 inches over the Great Plains and 2 to 3 inches over the entire South. Local flooding occurred in connection with the more torrential of these rains and a considerable acreage of wheat and cotton was destroyed in south-central Oklahoma. One of the most destructive spring floods in years occurred along the Arkansas River in southeastern Colorado, isolating at least 2,000 people and destroying bridges and closing highways. Other flash floods were reported in several areas in Texas, Oklahoma, and New Mexico.

The region was visited by yet a third intense storm whose center passed across the Lower Great Plains from the Far Southwest on the 26th and thence northeastward toward the Great Lakes. A squall line associated with this storm furnished further soaking rains over a broad area so that by month's end there could no longer be any question of drought in the Plains States.

The spring's most devastating tornadoes also sprang from the latter squall line. In the early morning of May 26, Udall, a community of 500 persons in south-central Kansas, was virtually obliterated with about 70 people killed and 200 injured. At Blackwell, Okla., a tornado demolished a 36 square-block residential and factory area and claimed 18 lives with some 500 additional persons injured (see Weather Notes, p. 109). Other tornadoes were reported from Sweetwater, Okla., Oxford, Kans., Jessieville, Ark., and Wathena, Kans., with numerous funnels observed at other locations.

In order to relate the above series of events to the large-scale circulation features, the mean 700-mb. flow pattern (fig. 1) has been divided into two periods. During the first (fig. 3A) the Mississippi Valley was overlain by a ridge at the 700-mb. level with isobars curved anticyclonically over the Plains States. The combined effect of these was to effectively inhibit precipitation. Further, that portion of the flow which represented a departure from the normal was easterly over the Southern Plains with a trajectory such that it had little opportunity to acquire a moisture supply from the Gulf of Mexico. Figure 5A is representative of rainfall distribution during

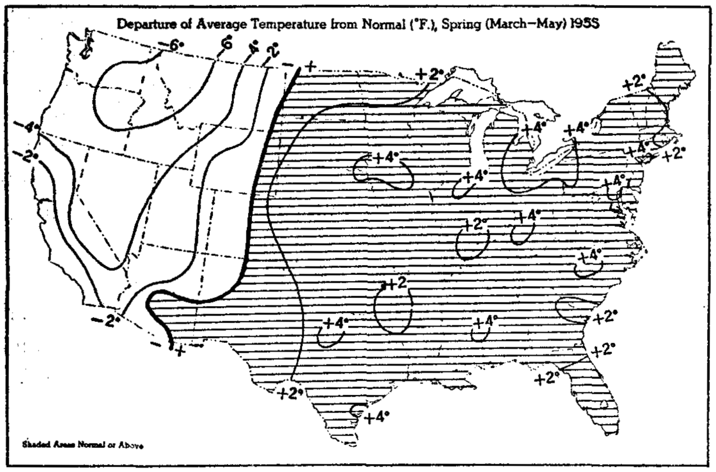


FIGURE 6.—Departure of average temperature from normal (° F.) for the spring season, March–May 1955. This spring was persistently cold in the area west of the Continental Divide with the remainder of the United States warmer than normal. In particular, the anomaly of 6° below normal centered over northern Idaho is an unusually large spring departure. (From *Weekly Weather and Crop Bulletin, National Summary,* vol. XLII, No. 24.)

this period and illustrates the relative dryness of the regime.

Conversely, the air flow during the latter half month had cyclonic curvature over the eastern slopes of the Rockies and the anomalous flow was southerly over East Texas and Louisiana, thus insuring a good moisture supply. Thus the observed pattern as illustrated in figure 5B is explainable in terms of the mean circulation as well as in terms of its individual components.

4. THE TEMPERATURE PATTERN

The most striking aspect of the pattern of temperature anomaly (Chart 1B) was the continuance for the sixth successive month of markedly below normal temperatures in the western third of the country. This month therefore brought to a close an unusually cold winter and spring season in the region west of the Divide. April 1955 was described [3] as one of the coldest on record in the West and the pattern established (cold in the West—warm in the East) persisted strongly into May. That such persistence is not the usual sequence from April to May has been demonstrated by Namias [4 and 5] who found persistence to be a minimum during this period for the decade he studied (ending 1951). In fact, he found a slight tendency to reversal of anomaly pattern from April to May. Klein [1] and Aubert [6] have treated the individual Mays of 1954 and 1950 in which such a reversal ensued. In the light of this tendency the remarkable similarity of thermal pattern between April and May of this year was all the more striking. A convenient statistic for measuring persistence from one month to the next is a simple count of the number of stations out of 100 selected cities which remained in the same or in an adjacent temperature class. When this was computed for April and May 1955 it was found that 98 stations fell within this tolerance zone. Thus the same pattern dominated both months and any reversal of pattern for this year was delayed until early June when a sweeping and abrupt transition occurred.

To permit comparison, figure 6 has been included to illustrate the distribution of temperature anomaly for this spring. It is noteworthy that departures as large as −4° F. are found over most of the West with a minimum of −6° centered in northern Idaho. For seasonal values these represent abnormalities of large magnitude and in the Northwest this spring was one of the most persistently cold on record. Unusually low temperatures were also reported for individual days and on the 16th a minimum temperature of 17° was observed as far south as Maverick, Ariz. Freezing temperatures occurred in the central and northern Rockies and in the Great Basin as late in the season as May 27 and 28, causing some damage to crops and truck gardens.

Contrariwise the eastern two-thirds of the country, both for this month and for the season as a whole, were relatively warm. Monthly anomalies (Chart 1B) as high as +6° were recorded in the North Central States with daily temperatures frequently reaching summertime levels. An early period heat wave resulted in maxima in the 90's in this area with Chicago and Detroit recording early season highs of 92° and 88° respectively on the 3rd. The Southeast was similarly unseasonably hot with Jacksonville, Fla., and Macon, Ga., and Charleston, S. C., reporting maxima of 98°, 95° and 96°, respectively, on the 12th. The overall warmth prevalent east of the Rockies was interrupted, however, by periodic invasions of cooler Pacific air so that the region of extreme warmth relative to normal was restricted to a much smaller area than in April. One cold snap on the 10th was sufficient to produce frost in central and southern New England and sub-freezing temperatures occurred again on the 18th over the central and northern Appalachians with frost along the Atlantic Seaboard.

REFERENCES

1. W. H. Klein, "The Weather and Circulation of May 1954—A Circulation Reversal Effected by a Retrogressive Anticyclone During an Index Cycle," *Monthly Weather Review,* vol. 82, No. 5, May 1954, pp. 123–130.
2. D. F. Rex, "Blocking Action in the Middle Troposphere and Its Effect Upon Regional Climate. II. The Climatology of Blocking Action," *Tellus,* vol. 2, No. 4, Nov. 1950, pp. 275–301.
3. A. F. Krueger, "The Weather and Circulation of April 1955—Another Cold Month in the West," *Monthly Weather Review,* vol. 83, No. 4, April 1955, pp. 95–97.
4. J. Namias, "The Annual Course of Month-to-Month Persistence in Climatic Anomalies," *Bulletin of the*

American Meteorological Society, vol. 33, No. 7, Sept. 1952, pp. 279–285.

5. J. Namias, "Further Aspects of Month-to-Month Persistence in the Mid-Troposphere," *Bulletin of the American Meteorological Society*, vol. 35, No. 3, March 1954, pp. 112–117.

6. E. J. Aubert, "The Weather and Circulation of May 1950," *Monthly Weather Review*, vol. 78, No. 5, May 1950, pp. 81–83.

Weather Notes

TORNADOES AT BLACKWELL, OKLA., MAY 25, 1955

On Wednesday, May 25, the wind was east-southeast all day. At approximately 4 p. m. the barometer started to fall from 30.05 inches. By 9:00 p. m. the barometer was steady at 29.64 and started to rise. The clouds that were approaching from the west were not bad looking at all. When the storm hit Blackwell (at 9:27 p. m.) my barometer was reading 29.72 and by 4 p.m. on the 26th it was back to 30.00.

The maximum temperature for the 25th was 78° F. I had set the thermometers at 7 p. m. with the temperature at observation time reading 74° as the clouds seemed to gather in the west. The temperature remained at 74° until the storm struck and went to 80° which was also the 24-hr. maximum on the 26th. I noted that the recording thermometers at the Journal and Consolidated Gas Office both showed a sharp rise to 80° at the time of the storm, 9:27 p.m.

Hailstones that measured 2¼ inches fell in my yard just before the storm struck. A friend picked up some in his yard that measured 2½ inches in diameter on a steel scale. Jumping from the north porch of his house into the yard to pick up hailstones, he happened to look around the corner of the house to the south and saw the solid black wall approaching. He took refuge in the hallway of his house. He and two others tell me that they did not hear any noise at all.

One lady who took cover under a stairway ended up one-half block away—still under the stairway, which was all that was left of her two-story house. She tells me the storm was a black wall and the lightning went up from the ground to the cloud—not from the cloud to the ground.

I stood in the door of my storm cellar and watched the storm go through town. The wind at my place, nine blocks west of the main path, was a dead calm. The storm sounded like a roaring freight train going through open country, only louder. As the funnel was directly east of me, the fire up near the top of the funnel looked like a child's Fourth of July pin wheel. It was something I will not forget for a long time.

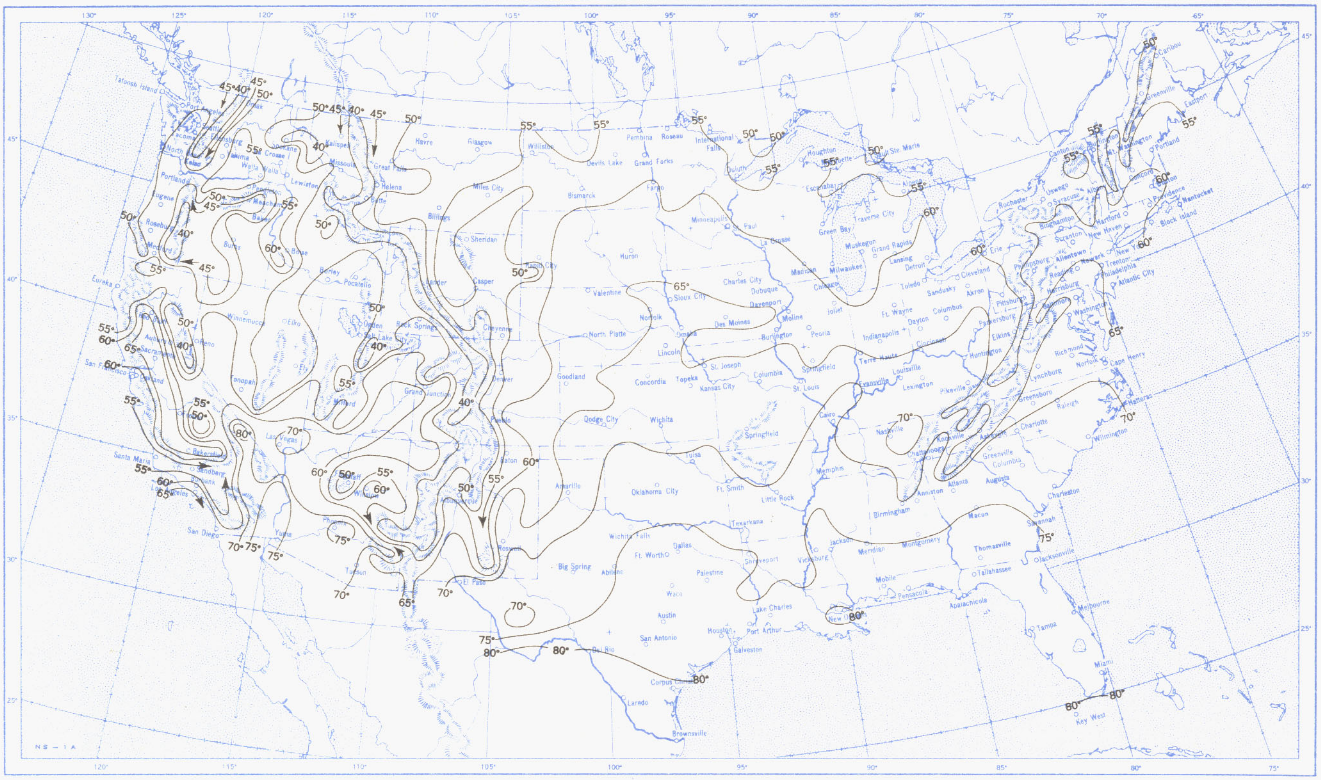
I walked out to my back fence after the main storm passed and was listening to the noise die away when all at once the noise came back clearly. I ran back to the cave and said, "It's coming back." Then I looked again and there was a smaller one in the air about one-half mile behind the first one. It came down North First which is about six blocks east of my home, and about five blocks west of the main storm path.

Two miles south of Tonkawa along the Salt Fork River there was evidence of the storm starting at the mouth of the Chikaskia and Salt Fork. On the west side of the Chikaskia it started north along the river and got bigger as it went.

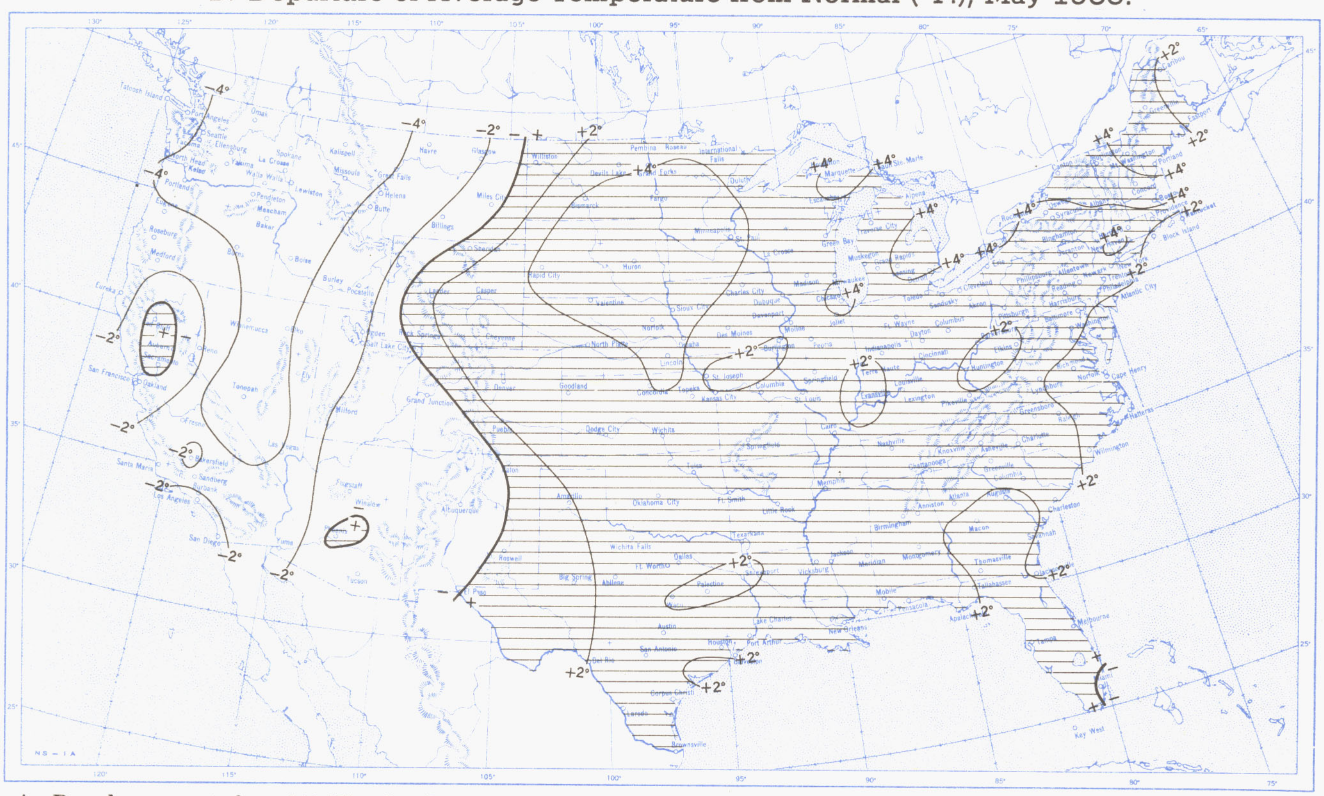
This is the fourth storm I have been through here at Blackwell. Always before they have come in from the west, cut a path, hit the river and broken up.—

Floyd C. Montgomery, Observer, Blackwell 2, Okla.

Chart I. A. Average Temperature (°F.) at Surface, May 1955.

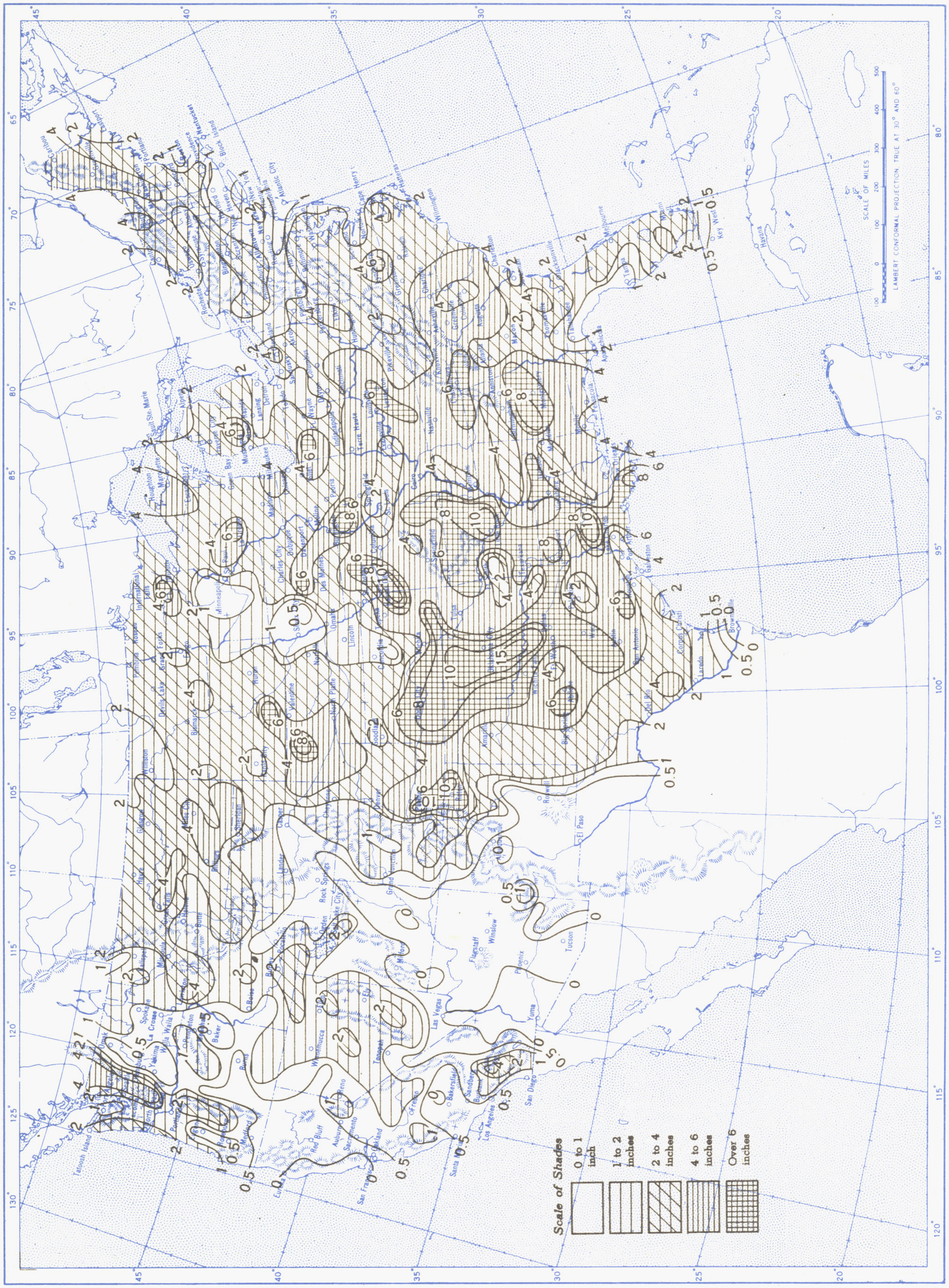


B. Departure of Average Temperature from Normal (°F.), May 1955.



A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

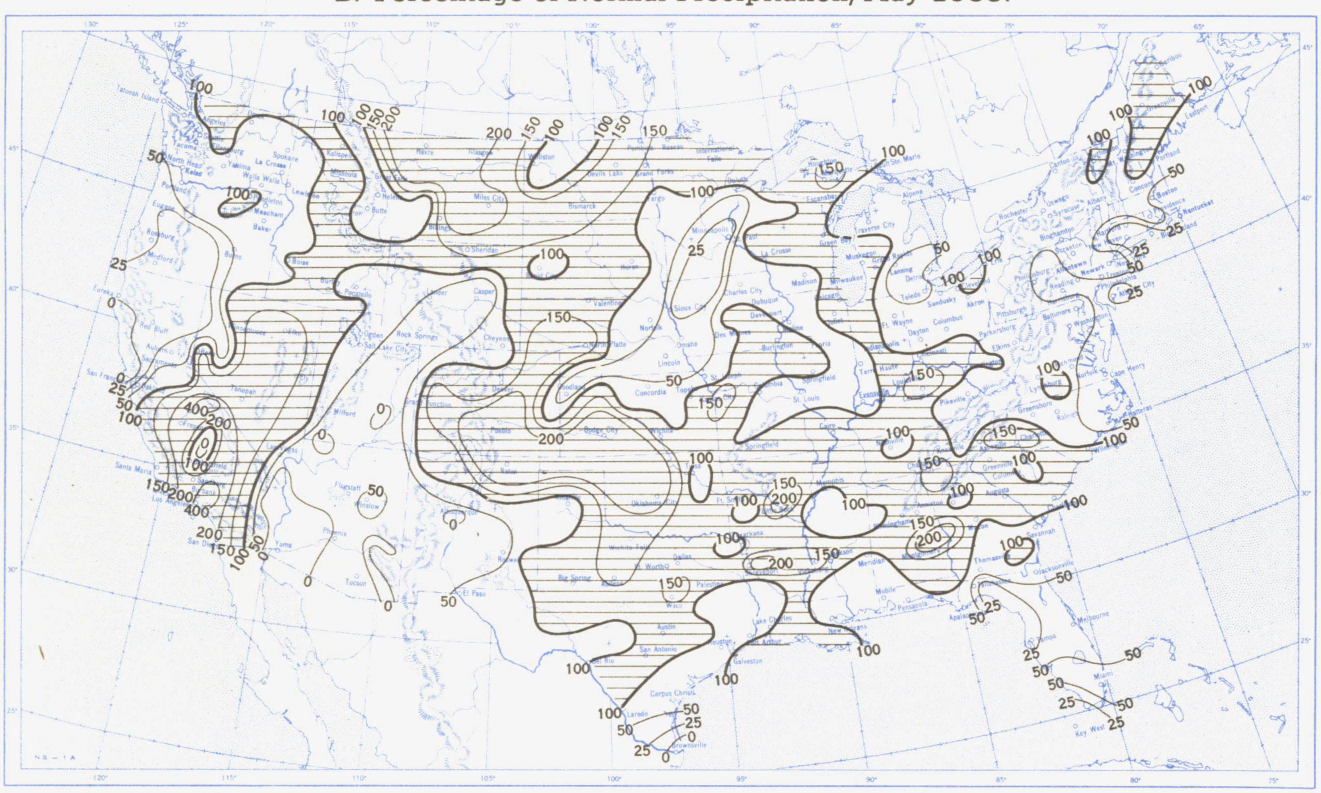
Chart II. Total Precipitation (Inches), May 1955.



Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

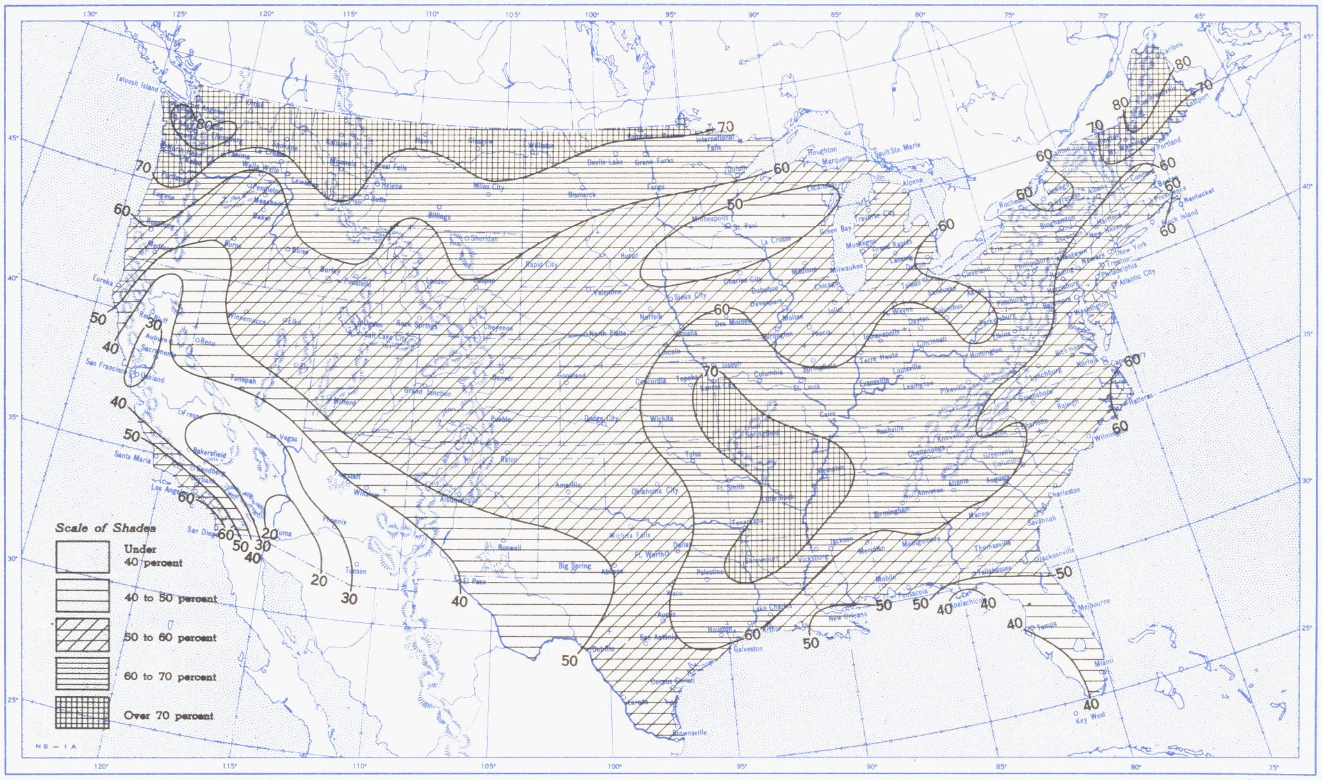
Chart III. A. Departure of Precipitation from Normal (Inches), May 1955.

B. Percentage of Normal Precipitation, May 1955.

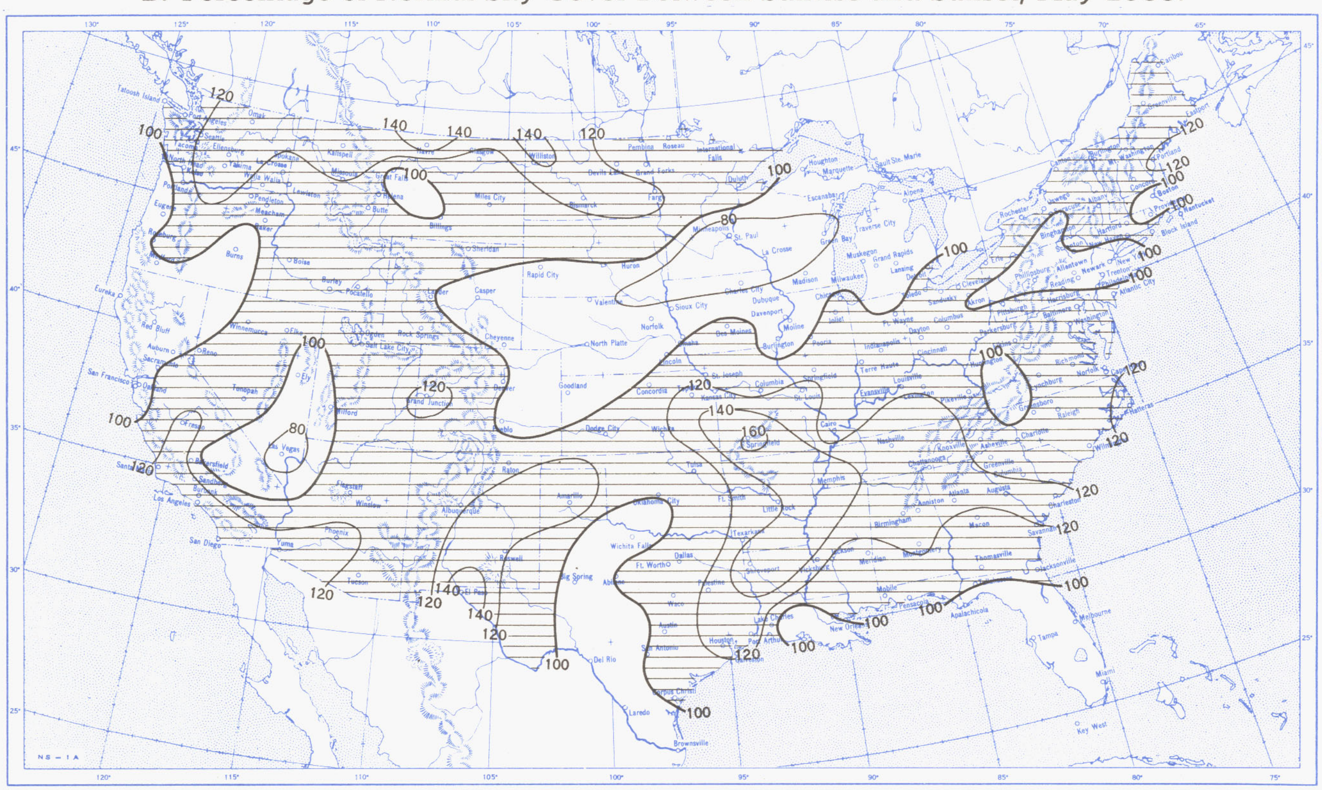


Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, May 1955.

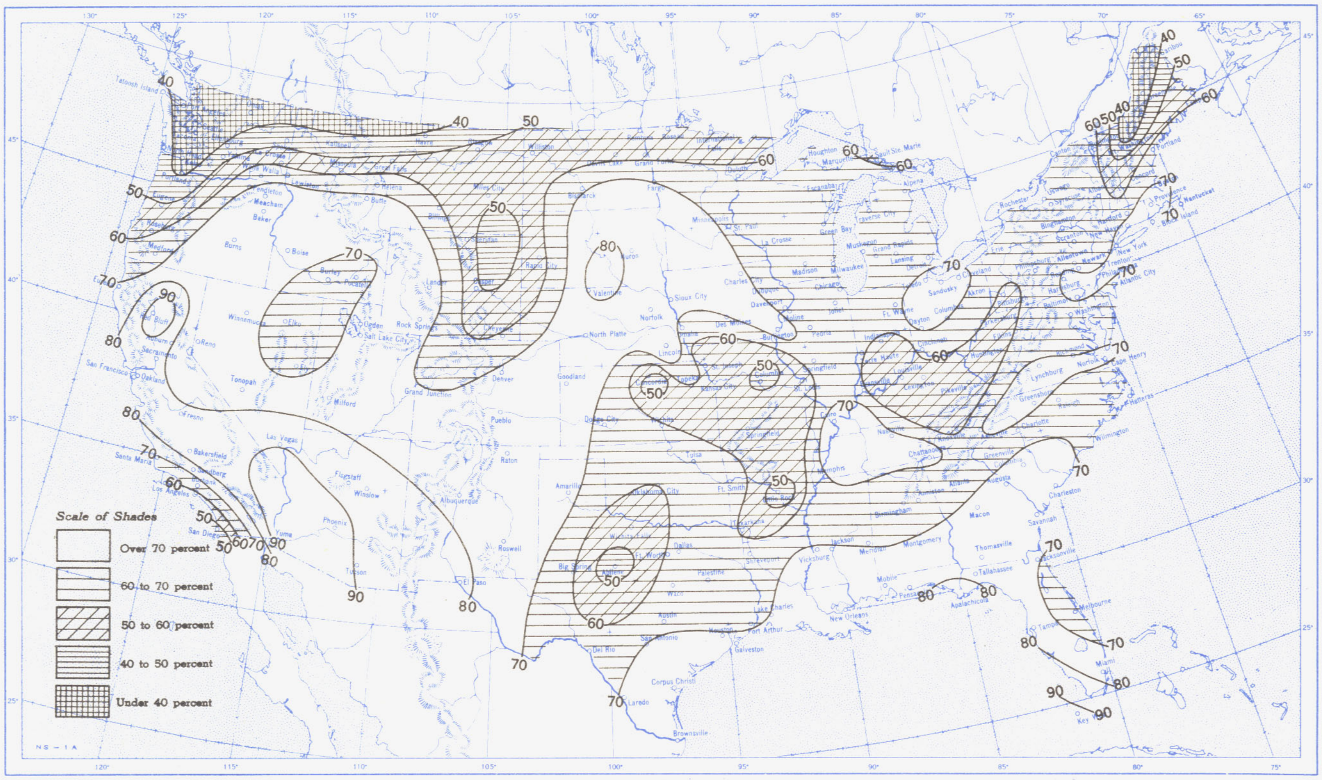


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, May 1955.

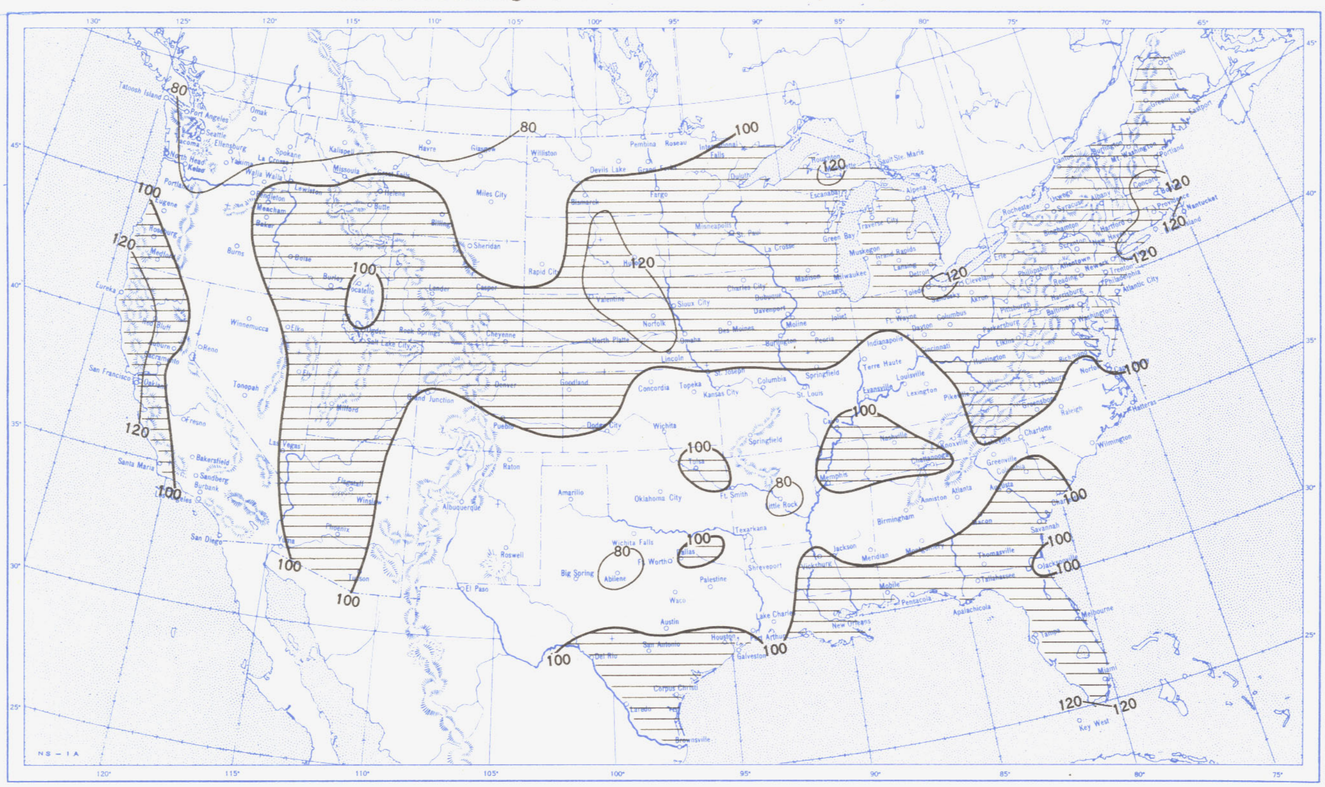


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, May 1955.



B. Percentage of Normal Sunshine, May 1955.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, May 1955. Inset: Percentage of Normal Average Daily Solar Radiation.

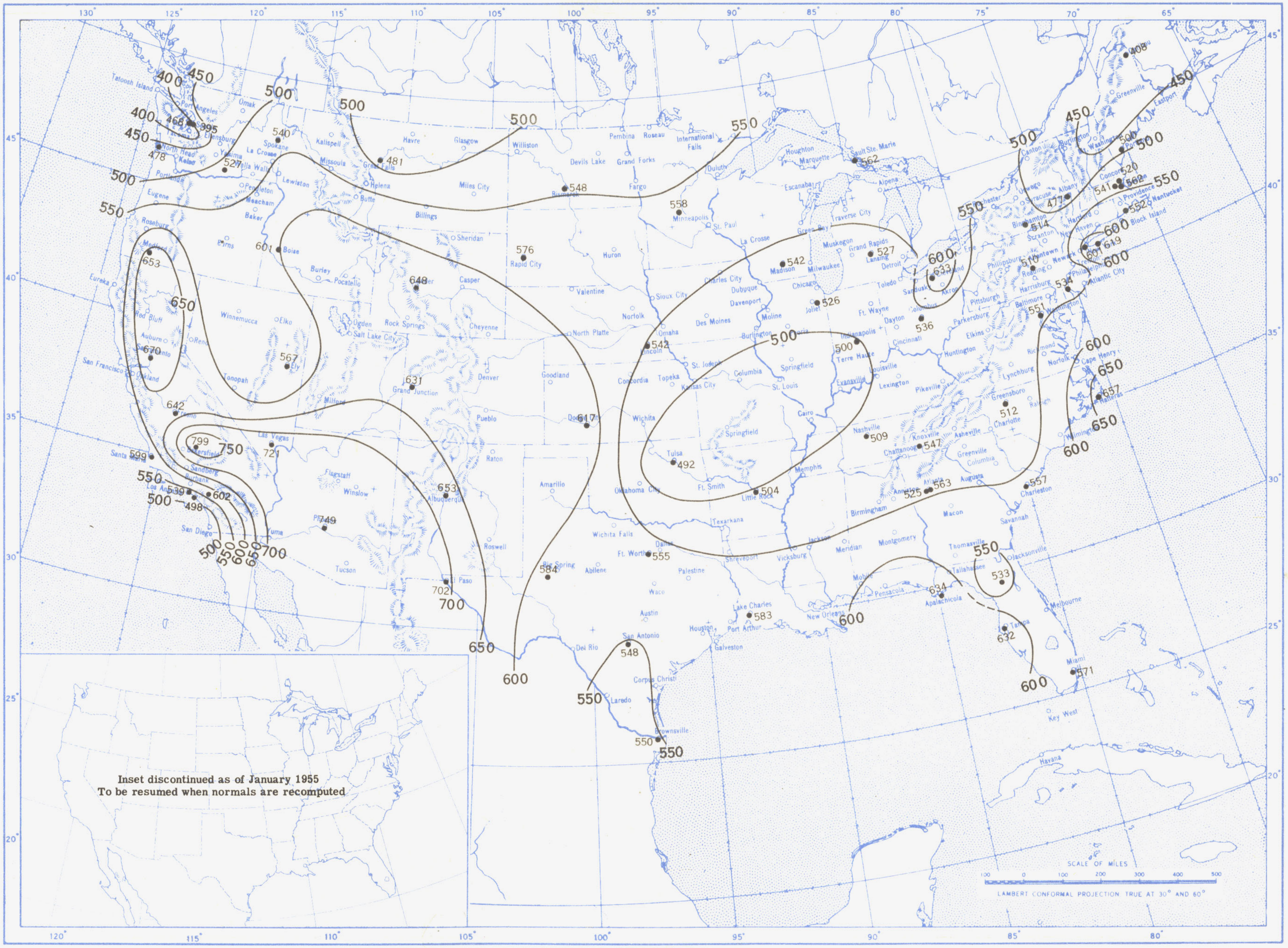
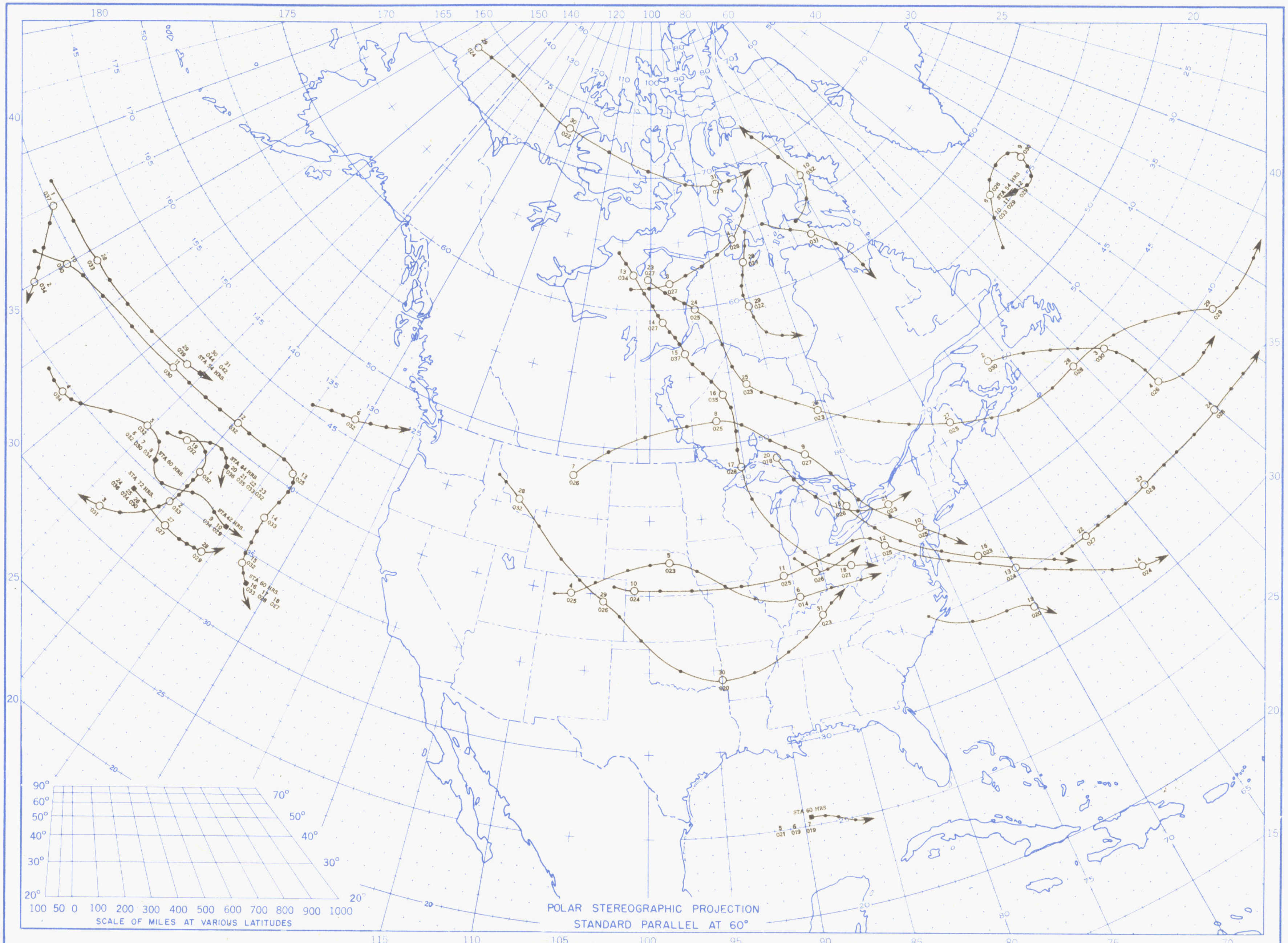


Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm.$^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, May 1955.

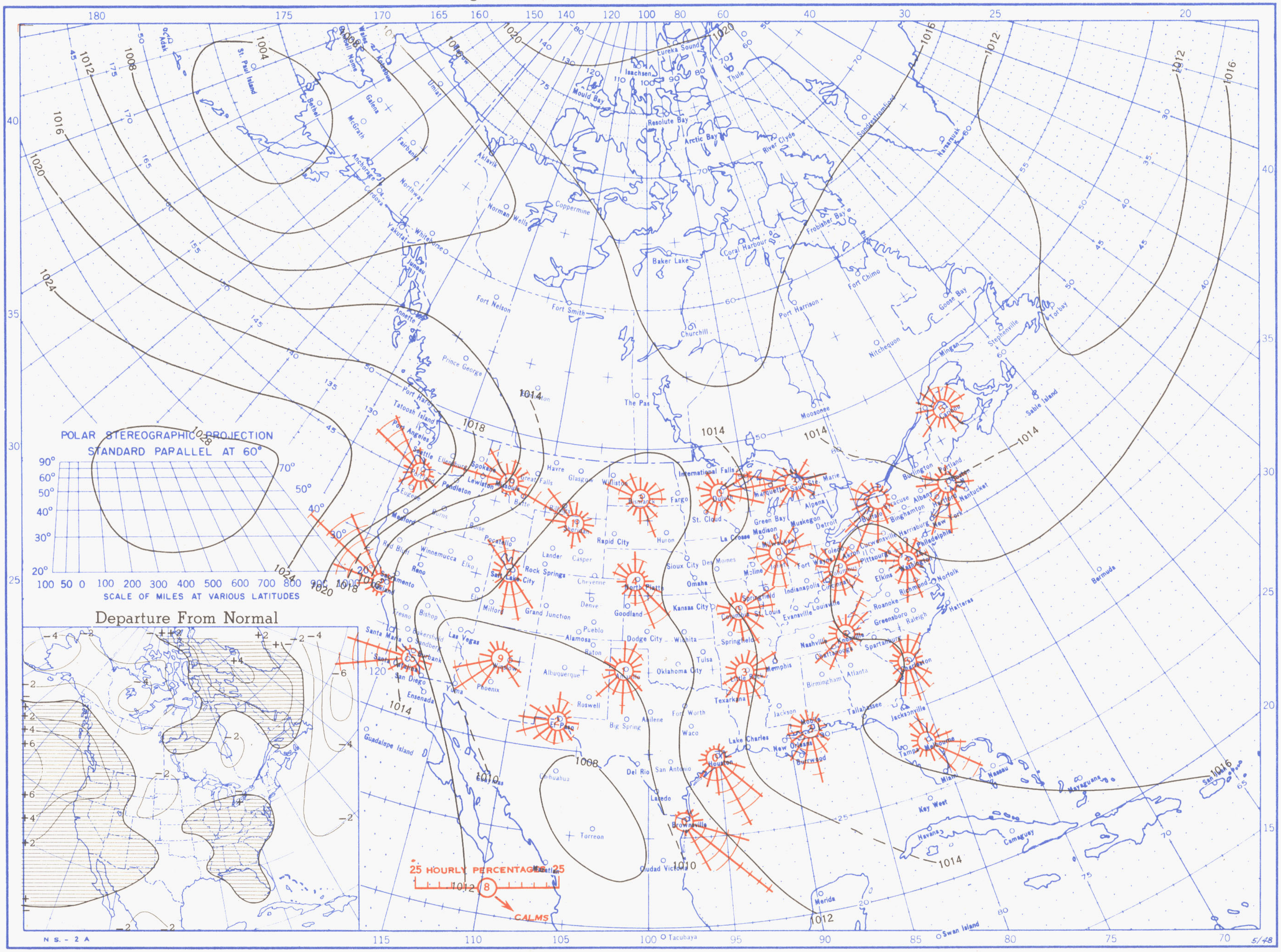


Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, May 1955.

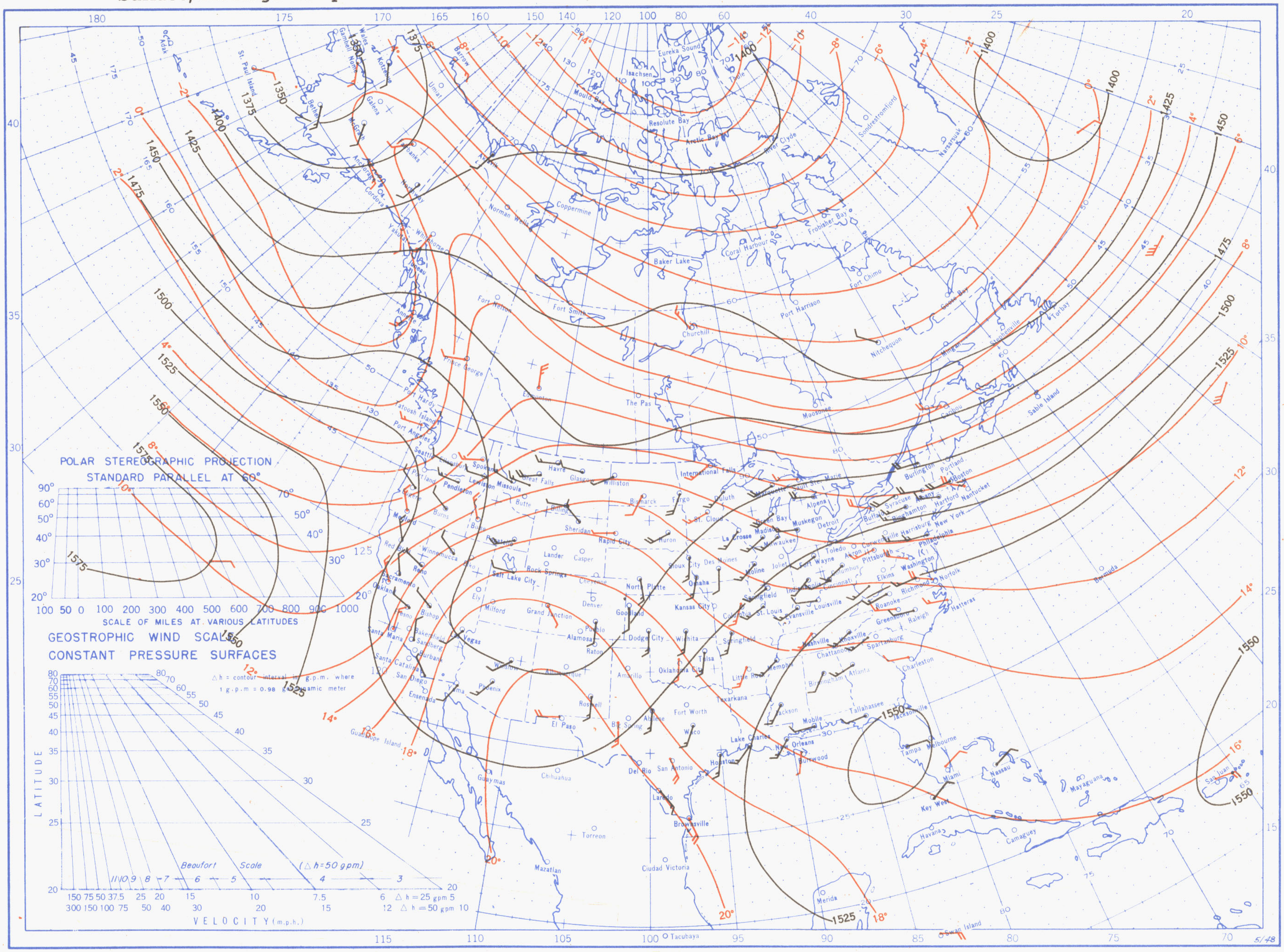
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, May 1955. Inset: Departure of Average Pressure (mb.) from Normal, May 1955.



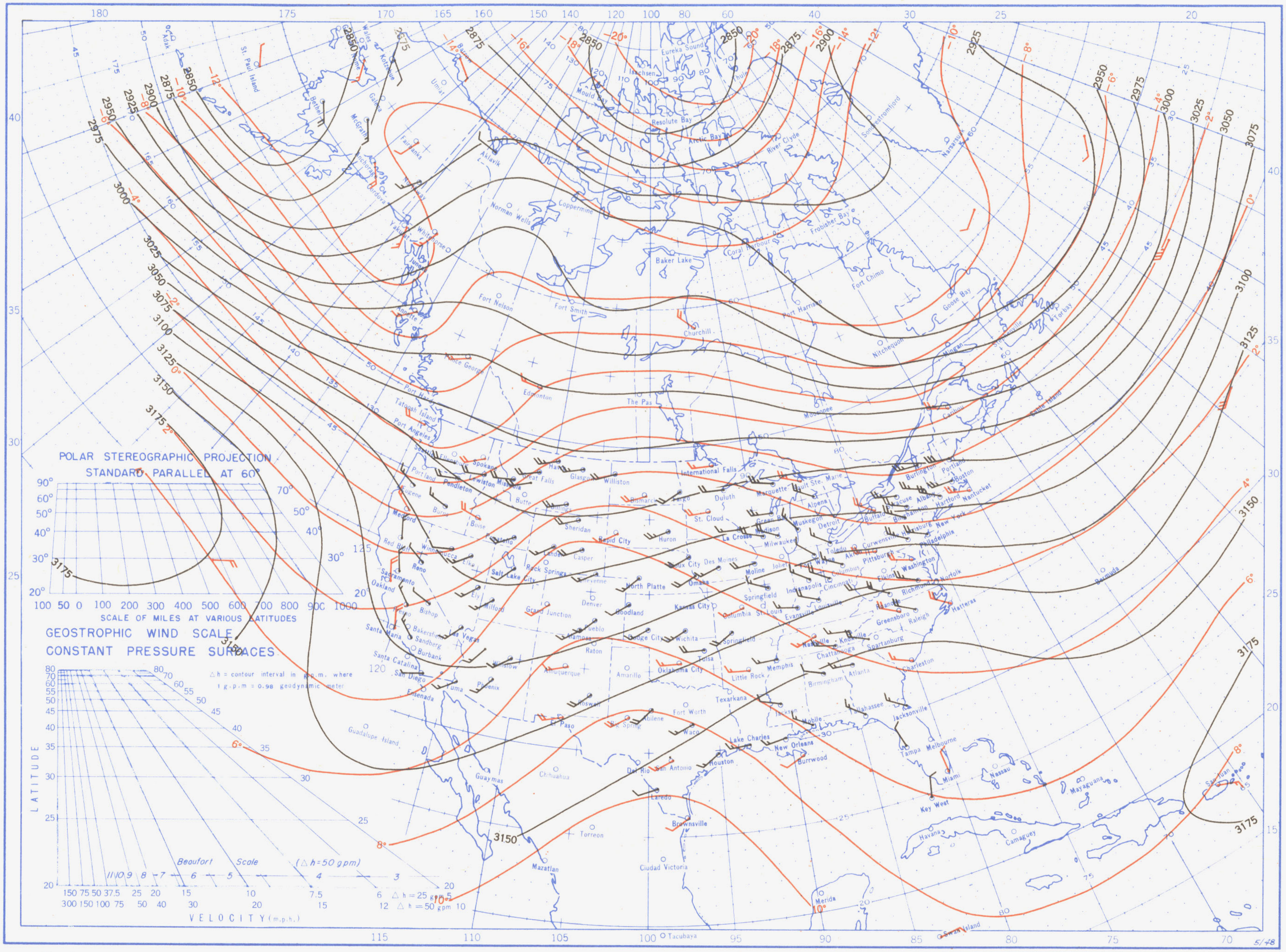
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), May 1955.



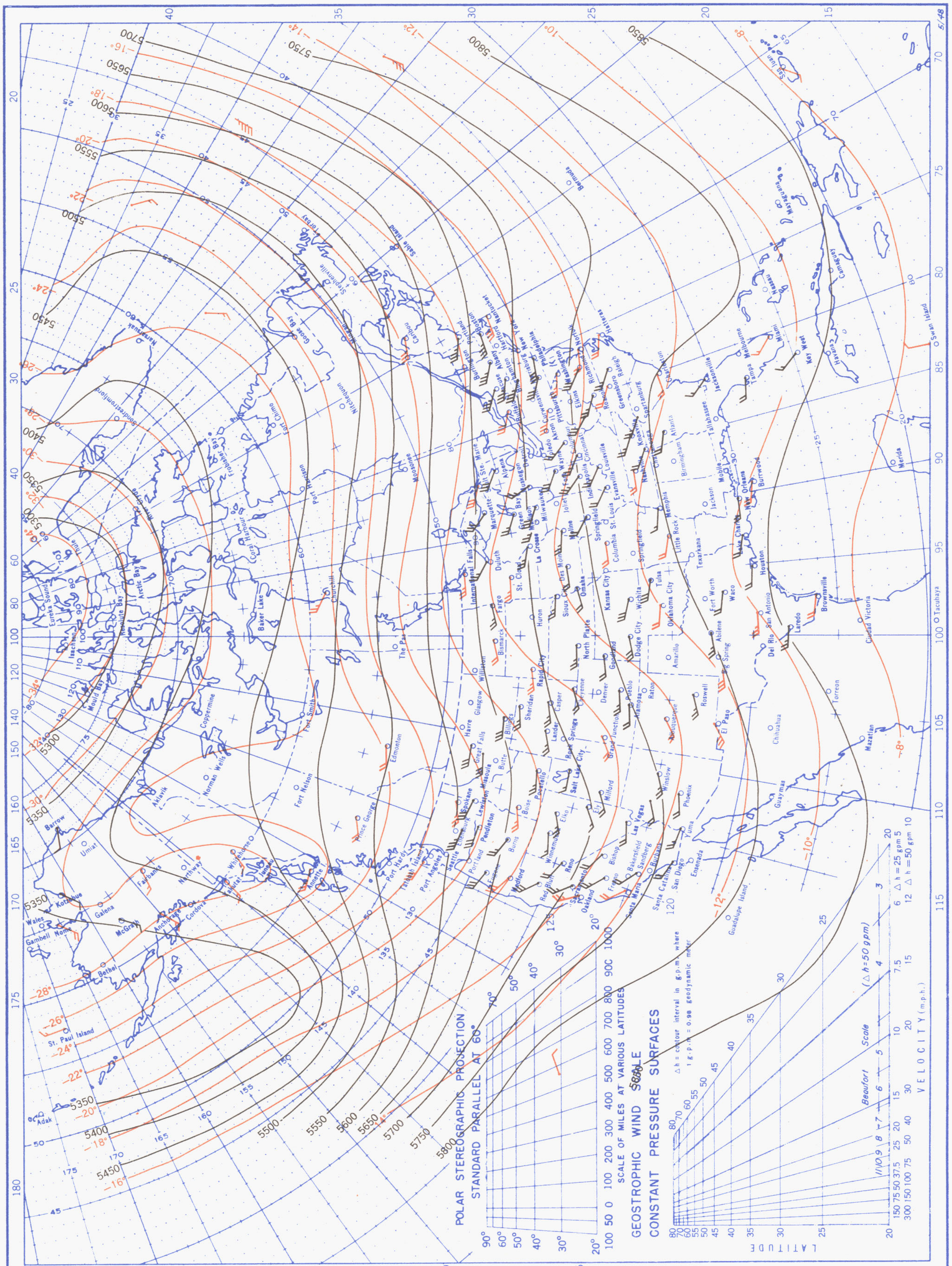
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m.. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), May 1955.



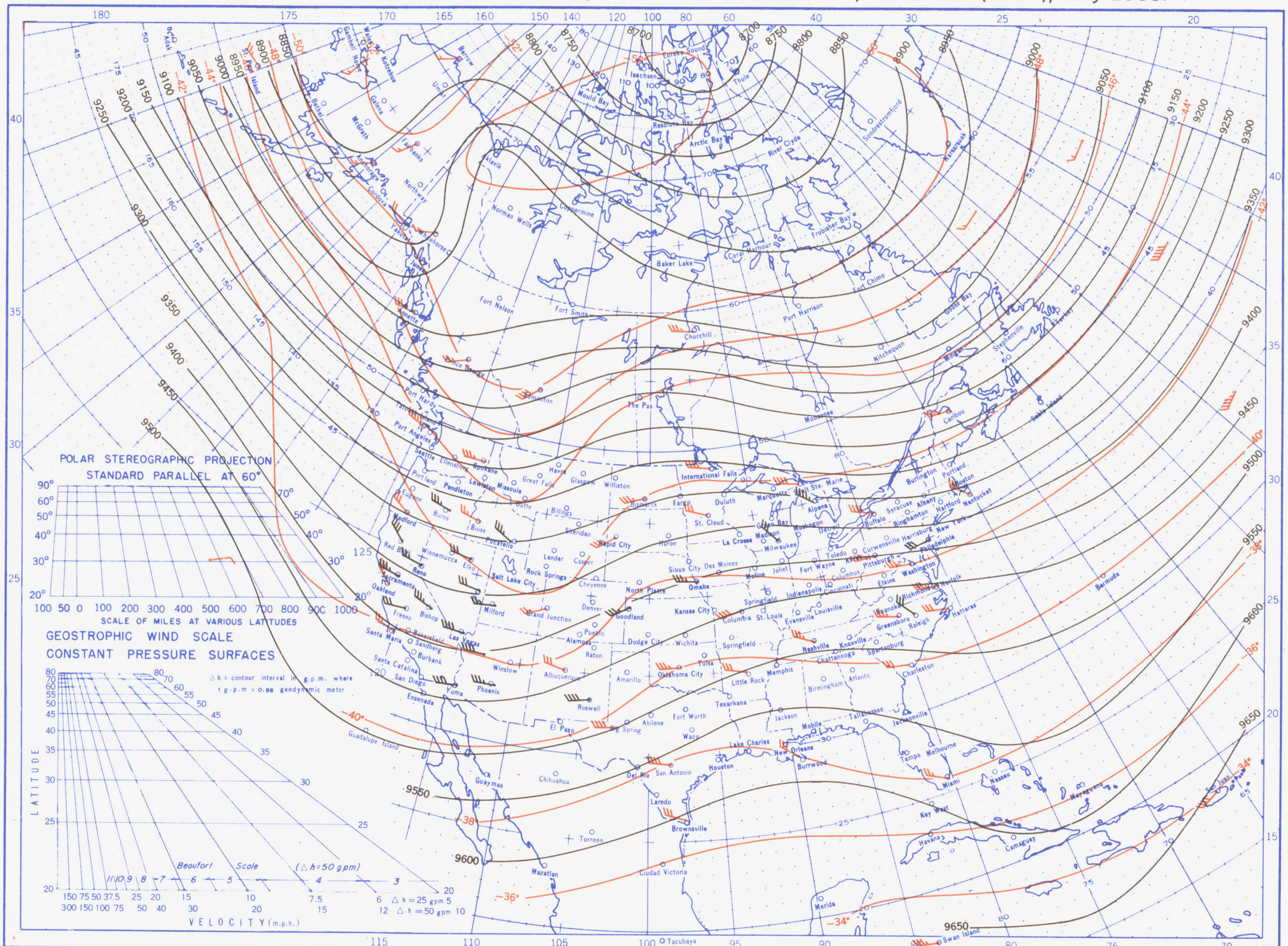
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), May 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), May 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.